

Petawatt laser probes nature at Texas university

Some things really are bigger in Texas—the petawatt laser built by scientists and engineers at the University of Texas at Austin, for one. “[It] is the highest-power laser in the world,” says Todd Ditmire, director of the Texas Petawatt Laser, which held a ribbon-cutting ceremony on 28 August.

The laser has a peak power of 1.2 PW, or 1.2×10^{15} watts. New amplification technology, namely, a combination of nonlinear optics and doped glass to amplify a broad range of wavelengths, has shrunk the pulse duration down to 165 femtoseconds, from 600 fs at the only other petawatt lasers yet built—one in the UK and one, since decommissioned, at Lawrence Livermore National Laboratory. The shorter pulse time means target materials can be heated faster “than anything expands,” Ditmire says, “and you can get plasmas with solid—or higher—densities.”

A key area of study will be fundamental properties of such dense plasmas: “Electrical conductivity, the equation of state—the sort of thing that astrophysicists want to know,” says Ditmire. The petawatt laser will also be used to accelerate electrons by having them surf on plasma waves. “We should be able to get to 10 GeV,” says Ditmire. “That’s starting to get into a regime in which high-energy physicists might take notice.” Other lines of research include looking at aspects of inertial confinement fusion and ejecting protons from one material to heat a second target to fusion temperatures.

The first research effort, Ditmire says, will be to focus the beam into a gas of deuterium clusters, a few thousand atoms per cluster. “The laser ejects the electrons, leaving a ball of ions. These ions repel each other and the ball explodes.” The resulting ions can fuse with ions from other exploded clusters. “It’s not interesting for energy production, but it’s a bright burst of fusion neutrons,” he says. The neutrons, he adds, can be used in pump-probe materials studies.

The petawatt’s \$15 million tab was footed by the National Nuclear Security Administration through earmarks in energy and water appropriations bills obtained thanks to Texas Republican Senator Kay Bailey Hutchison. “Senator Hutchison has long championed efforts to strengthen innovation and research at our nation’s education institutions,” says aide Courtney Sanders. Hutchison, a member of the Senate Committee on

TEXAS PETAWATT GROUP



Front-end amplifiers fill one of three rooms that make up the world’s most powerful laser. The Texas Petawatt Laser Facility uses power amplifiers scavenged from Nova, an earlier laser from Lawrence Livermore National Laboratory.

Appropriations, was “proud to help make the project possible through federal funding,” Sanders says. The information gleaned from experiments with the laser will “improve our ability to certify the reliability of the aging US nuclear weapons stockpile without underground nuclear testing,” adds NNSA spokesman John Broehm. “Universities are a great resource to better our understanding of the physics and are independent of NNSA methods and conclusions. . . . It is extremely helpful to have this outside perspective.”

“Importantly,” says Ditmire, “this is the only petawatt laser on a university campus in the US. It will play a significant role in educating students in high-intensity laser and high-energy-density science.” Although the laser will not be used for classified research, he adds, “NNSA wants us to train good students who could then go work for the weapons labs.” Mechanisms for outside researchers to use the petawatt laser are still being formulated.

Toni Feder

Kaname’s predecessor at ITER, Robert Aymar, says the damage caused by the missed US payment will be difficult to undo and may cost the US its chance to host the ILC. Pledges of support from partner nations must be “robust,” he says, capable of riding out elections or sudden shifts in domestic policies that may occur in each contributing nation.

Aymar, who is retiring in December as director-general of CERN, says the US is hardly alone in having to cope with such “accidents.” But, he adds, the US may be the only contributor that has both constitutional and cultural impediments to meeting its international commitments. Constitutionally, he notes, one Congress cannot instruct succeeding

Congresses to appropriate funding for anything. Culturally, although the ITER agreement doesn’t carry the same force as a treaty, Aymar observes that the US is the only ITER party that hasn’t ratified the Vienna Convention on the Law of Treaties. That pact commits signatories to abide by their treaty obligations even if they conflict with domestic policies. Finally, he says, the US frequently makes unilateral foreign policy decisions without consulting other nations.

“The US is a large country that assumes it can do everything alone, and that is [often] true. But in that case, in principle it cannot be a partner,” Aymar maintains. With ITER now in the construction stage, a US default or with-

drawal would do much more damage than the last time the US jilted ITER, in 1999. (It rejoined in 2003.)

ILC curtailed

Barry Barish, a Caltech professor who heads the worldwide ILC R&D collaboration, believes the ITER cut was more damaging to US prospects for hosting the ILC than was the big hit the ILC program itself took in the December budget crunch. The \$35 million for the ILC that congressional appropriators have provided for fiscal year 2009 will appear to be a big leap from the \$15 million of FY 2008, but it’s actually back to the FY 2007 level. With the US providing about 30% of the worldwide total,